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(71) Applicant
Crosfield Electronics Limited, 766 Holloway Road, London N19 3JG
(72) Inventor
Edward Russell Wood
(74) Agent
Gill Jennings & Every

(54) Production of Reflective Surfaces

(57) To ensure that the facets of a mirror drum are accurately located, each facet body is formed from a plastics resin cast against an optically flat surface and is formed with locating means accurately positioned in relation to the optically flat surface, the flat facet body surface being given a reflective coating. The assembly of the coated facet bodies on the drum is effected using the locating means formed on the facet bodies and co-operating locating means formed on a drum core or on discs defining the end of the drum. The plastics resin may be cast in a trough having the optically flat surface as a removable base or in a mould formed with an elongate channel providing an elongate open upper face over which the optically flat surface is placed. Metal reinforcing bars may be located in the cast resin body or may be bonded to the surface of the cast resin body. In Figure 5, the stems of T-section metal reinforcing bars serve as the locating means and seat in precision-cut channels in the drum core.

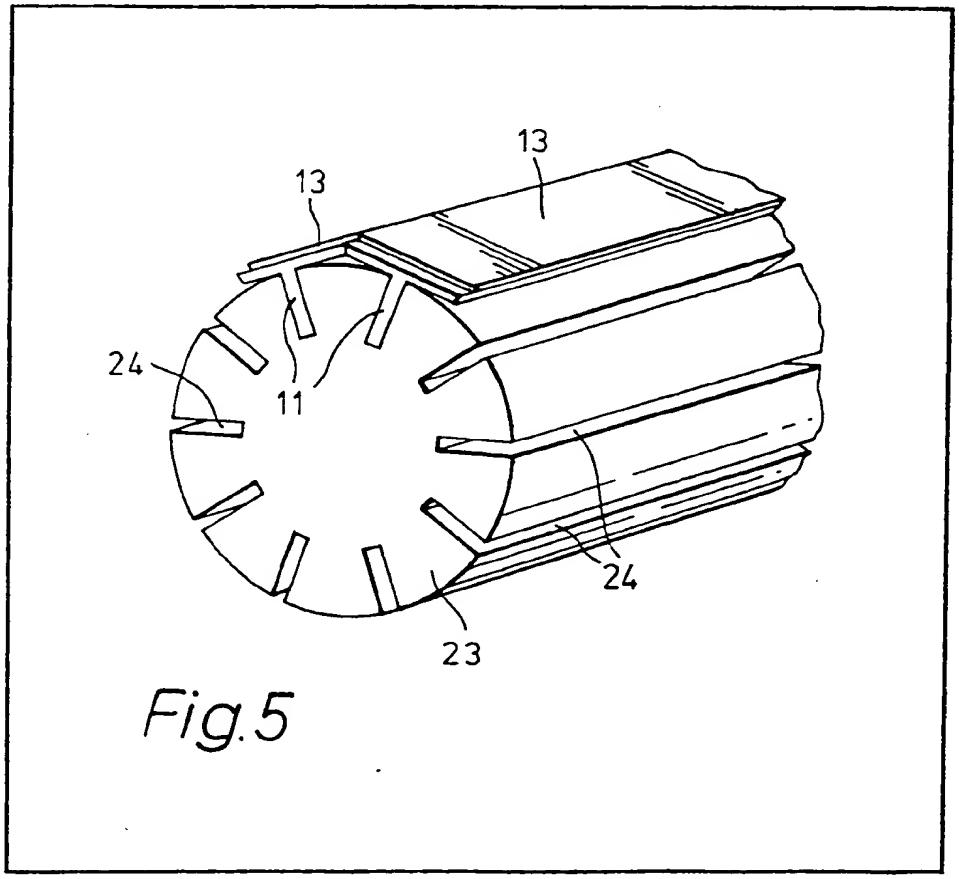


Fig.5

Fig.1

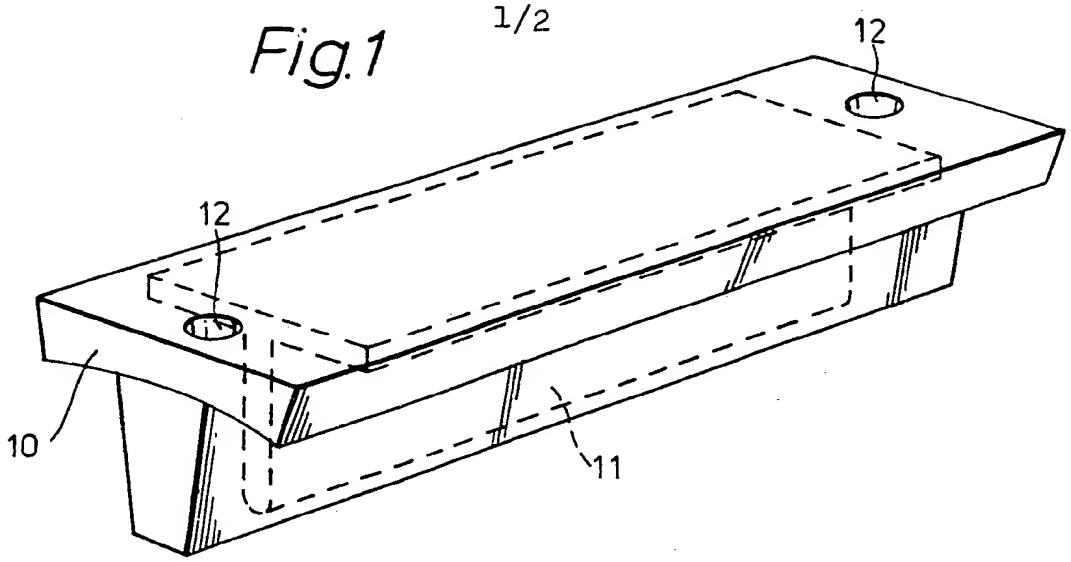
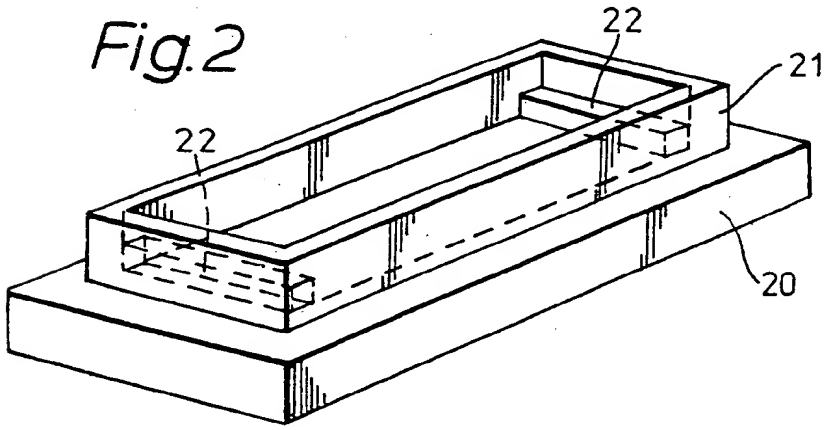


Fig.2



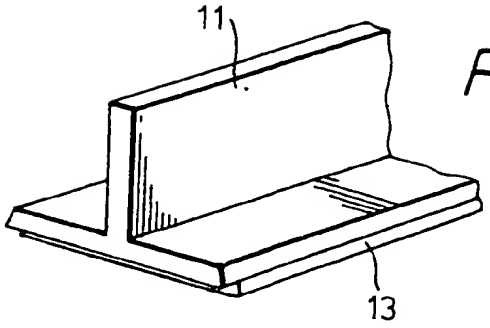


Fig.3

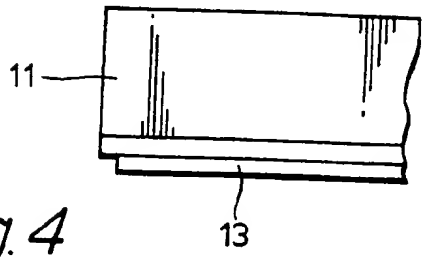


Fig.4

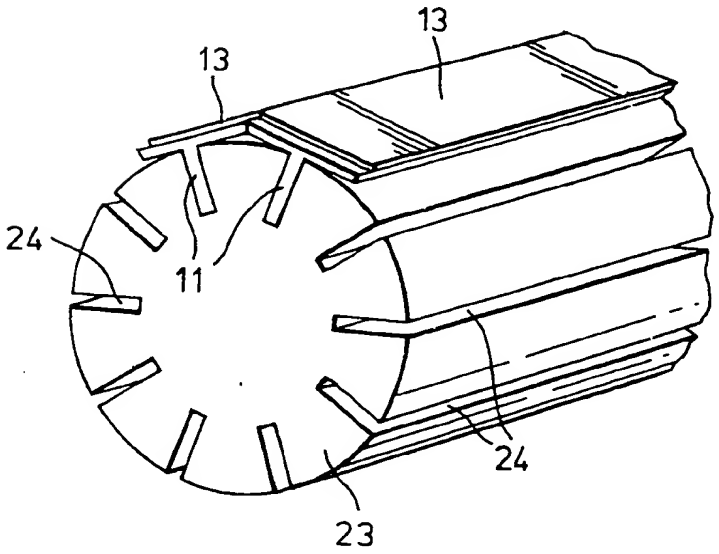


Fig.5

SPECIFICATION

Production of Reflective Surfaces

This invention relates to the production of mirror drums, i.e. drums the periphery of which consists of a number of facets with a highly reflective surface.

One important application of a faceted mirror drum is in a form of apparatus for viewing a stationary image of a portion of a moving web. In this form of apparatus, a mirror drum is rotated in front of the web about an axis perpendicular to the direction of movement of the web, and parallel to the plane of the web. An oscillating mirror reflects light from one part of the periphery of the drum to an observer, who sees a stationary image of the web reflected by each drum facet in turn. If the number of facets and the speed of rotation of the drum are suitably related to the speed and repeat length of the web pattern, the observer sees a stationary image. However, the production of a mirror drum by attaching individual plane mirrors to end plates themselves fixed to a central shaft gives rise to considerable difficulty, in particular, in connection with setting the mirrors on the drum facets at the correct angle. It will be appreciated that a very minor deviation in the angle of one facet can lead to a very large and unacceptable displacement of the image provided by that facet.

According to the present invention, a faceted mirror drum is produced by a method comprising preparing a coated facet body for each mirror facet by allowing cast plastics resin to cure against an optically flat surface and simultaneously forming or positioning locating means on the body in a known location with respect to the optically flat surface; after curing, separating the said optically flat surface and the co-operating resin face of the facet body; forming a reflecting coating on the said co-operating resin face of the facet body, either prior to or after its removal from the optically flat surface; and thereafter assembling a number of the coated facet bodies so that their reflective surfaces form the surface of a faceted mirror drum, the assembly being effected using the locating means formed on the facet bodies and co-operating locating means formed on a drum core or on discs defining the end of the drum.

In one method of carrying the invention into effect, a mould is formed with an elongate channel providing an elongate open face on one side of the mould and is shaped to produce locating means in a casting produced in the mould. To prepare each facet body, a plate having an optically flat surface is placed over the elongate open face of the channel to form a closure for that face, the mould is filled with a plastics resin, and after curing the closure plate is separated from the resin body and the mould. As before, a reflective coating is formed on the flat face of the resin body, either prior to or after its removal from the mould.

Preferably a metal reinforcing strip is moulded into each bar; this strip may be of aluminium and may have a T-shaped cross-section. If the position of the strip is precisely defined in relation to the optically flat surface, the locating means may be holes formed in the strip or the stem of the T-section.

In one method of forming a reflective coating on the resin body, a metal closure plate (for example of stainless steel) is coated with a metal of high reflectivity prior to being placed over the elongate open face of the channel with the reflective coating inwards. Then when the resin in the mould has been cured the separation of the plate from the mould and resin body takes place at the interface of the highly reflective metal coating and the plate, so that the cast resin body is left with a highly reflective coating. Alternatively, the coating on the closure plate may be of a metal having good release properties, in which case the cast resin body when removed will have a release coating on to which the highly reflective metal can be plated. In the above examples, the highly reflective coating may be nickel, in which case it is desirable to place a coating of silicon oxide over the nickel as a protective layer.

In yet a further alternative, the resin body, after its removal from the mould, can be given a highly reflective coating by vacuum aluminising. It is not essential to use metal for the closure plate and in one alternative form a closure plate of polymethyl methacrylate ("Perspex") is used. This substance can be obtained as a sheet with a very accurate flat surface and separates very easily from an epoxy resin casting. Also, it is cheap enough to be thrown away after one use.

Of course, it is not necessary to form each resin body in a separate operation. Preferably, the mould is formed with a number of elongate channels, each providing an open face at one surface of the mould, and the closure is now effected by placing a sheet, for example of stainless steel or "Perspex", over the whole of this mould surface. In this way, a large number of resin facet bodies can be made at the same time.

It will be appreciated that using the method in accordance with the invention, provided that the co-operating locating means are accurately formed the reflective mirror drum facets are automatically at the correct angles.

In the accompanying drawings, Figure 1 shows a cast-resin body produced by a method embodying the invention; Figure 2 illustrates the resin trough used in one method of carrying the invention into effect; Figures 3 and 4 are respectively a perspective view and a side elevation of a facet body; and Figure 5 shows two coated facet bodies assembled on a drum.

Figure 1 shows one of the epoxy resin castings 10 which, in the example shown, is of generally T-shaped cross-section and includes within its boundaries an aluminium T-shaped reinforcement 11. At the ends there are provided location holes 12, formed in the casting in the mould, to co-operate with locating pins on the drum core and

on end discs, or with corresponding holes in the drum core or end discs to receive fastening bolts. The reflective surface is subsequently formed on the upper surface of the resin body shown.

When the closure plates are of stainless steel, they may be ground and highly polished to a quarter-micron finish, using abrasive papers and diamond pastes. The polished plates are cathodically cleaned in a 45 gram/litre solution of trisodium phosphate at 80—85°C for 1 minute at a current density of 50 amps per square foot, thoroughly rinsed in tap water immersed in a ½% sodium dichromate solution for 30 seconds to 1½ minutes, and again thoroughly rinsed in deionised water. If a stainless steel with a chromium content of about 18% is used it will be inherently self-releasing from copper and nickel plate.

For coating such plates, we prefer to use an electroplating process but vacuum or vapour deposition and electroless chemical or reduction plating can also be used.

Where the stainless steel plates are given a release coating, this may be done by electroplating them with copper. After release of the resin body, the copper coating thereon may be electroplated with nickel and then coated with silicon oxide.

We prefer to use an epoxy casting resin but other low-shrinkage mixtures, both hot and cold-curing, can be used, including polyesters, polyurethanes, phenolics and melamines.

Figure 2 illustrates a method in which the resin is cast in a trough, the base of which is formed by the optically flat surface 20. The walls 21 of the trough are removable from the base and on the inner sides of the end walls there are provided support steps 22.

In this method, the flat surface is cleaned and, if desired, is coated with a release agent. The frame 21 constituting the walls of the trough is located on the optical surface, for example, by using dowel pins at each end. A cold-cure epoxy resin is mixed thoroughly and is poured into the trough up to at least the level of the support steps. In the preferred method, after a suitable de-gassing time (about 5 to 10 minutes) an aluminium T-bar which has been degreased and preferably abraded is carefully lowered on to the support steps so that it just touches the resin surface. The bar is pressed firmly down to ensure that it seats properly on the support steps. After the resin has cured, the frame 21 is removed from the flat surface 20 and the casting is removed from it.

The resin surface of the bar is then aluminised as described above.

In this case, the locating means may be holes formed in the aluminium T-bar, or the stem portion of the T-section bar may constitute the locating means.

In Figures 3 and 4, there is shown a preferred form of facet body produced by a trough similar to that shown in Figure 2 but having chamfered undersides on the long walls of the frame 21. The aluminium T-section bar 11 has a resin layer 13 on its surface. After aluminising of their resin layers, the coated facet bodies are assembled on a mounting cylinder (Figure 5), which is a solid aluminium rod 23 having precision-cut longitudinally extending channels 24 for receiving the stem portions of the T-section facet bodies, with their chamfered surfaces in contact.

Claims

1. A method of making a faceted mirror drum, comprising preparing a coated facet body for each mirror facet by allowing cast plastics resin to cure against an optically flat surface and simultaneously forming or positioning locating means on the body in a known location with respect to the optically flat surface; after curing, separating the said optically flat surface and the co-operating resin face of the facet body; forming a reflecting coating on the said co-operating resin face of the facet body, either prior to or after its removal from the optically flat surface; and thereafter assembling a number of the coated facet bodies so that their reflective surfaces form the surface of a faceted mirror drum, the assembly being effected using the locating means formed on the facet bodies and co-operating locating means formed on a drum core or on discs defining the end of the drum.

2. A method of making a faceted mirror drum, in which a mould is formed with an elongate channel providing an elongate open face on one side of the mould and is shaped to produce locating means in a casting produced in the mould, the method further comprising, to prepare each coated facet body: placing a plate having an optically flat surface over the elongate open face of the channel with the flat surface forming a closure for that face and filling the mould with a plastics resin; after curing, separating the closure plate from the co-operating face of the resin body and the mould and removing the resin facet body from the mould; forming a reflecting coating on the said co-operating face of the resin facet body, either prior to or after its removal from the mould; and thereafter assembling a number of the coated facet bodies so that their reflective surfaces form the surface of a faceted mirror drum, the assembly being effected using the locating means formed on the facet bodies and co-operating locating means formed on a drum core or on discs defining the end of the drum.

3. A method in accordance with claim 2, in which the closure plate is of metal and is coated with a metal of high reflectivity prior to being placed over the elongate open face of the channel with the reflective coating inwards, the separation of the plate from the mould and resin body taking place at the interface of the highly reflective metal coating and the plate so that the cast resin body is left with a highly reflective coating.

4. A method in accordance with claim 3, in which the closure plate is of stainless steel and the highly reflective coating is of nickel.

5. A method in accordance with claim 2, in which the closure plate is coated with a metal

having good release properties prior to being placed over the elongate open face of the channel with the release coating inwards and in which the cast resin body when removed has a release coating on to which a highly reflective metal coating is plated.

6. A method in accordance with claim 2, in which the resin body, after its removal from the mould, is given a highly reflective coating by vacuum aluminising.

7. A method in accordance with claim 2, in which the closure plate is of polymethyl-methacrylate.

8. A method in accordance with any one of the preceding claims, in which the resin used for the casting is epoxy resin.

9. A method in accordance with any one of the preceding claims, in which each facet body includes a metal reinforcing strip integral with the resin portion of the facet body.

10. A method in accordance with claim 8, in which the strip is of aluminium.

11. A method in accordance with claim 9 or 10, in which the reinforcing strip has a T-shaped cross-section.

12. A method in accordance with any one of claims 2 to 7, in which the mould is formed with a number of the said elongate channels, each providing an open face at one surface of the mould, and the closure of the open faces of the channels is effected by placing a single plate over the whole of the mould surface.

13. A method in accordance with claim 1, in which the optically flat surface forms the removable base of a trough for receiving the plastics resin.

14. A method in accordance with claim 13, in which the trough has supports for supporting a reinforcing strip in contact with the resin.

15. A method in accordance with claim 13 or 14, in which the inner long sides of the trough are chamfered, the angle of chamfer being such that when facet bodies produced in the trough are assembled to form the mirror drum there is surface contact between adjacent chamfered edges.

16. A faceted mirror drum made by a method in accordance with claim 1 or 2 and comprising a number of cast resin facet bodies having reflective surfaces which form the surfaces of the mirror drum, the locating means on the coated cast resin facet bodies co-operating with locating means on the core of the drum or on discs defining the ends of the drum.

17. A method of making a faceted mirror drum, substantially as herein described.

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